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Method and Apparatus for Creating a Wireframe and Polygon Virtual World

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METHOD AND APPARATUS FOR CREATING A WIREFRAME AND POLYGON VIRTUAL WORLD

This is a continuation of application Ser. No. 07/621,474 filed Nov. 30, 1990, now abandoned.

BACKGROUND OF THE INVENTION

This invention relates to virtual reality systems and, more particularly, to a method and apparatus for creating a virtual world from a database containing a limited pictorial representation of the virtual world.

Users of computer systems are now able to create virtual realities which they may view and interact with. One type of virtual reality system is disclosed in U.S. patent application Ser. No. 08/133,802, filed Oct. 8, 1993, which is a continuation of U.S. patent application Ser. No. 07/535,253, filed Jun. 7, 1990, now abandoned, entitled "Virtual Reality Network," the disclosure of which is incorporated herein by reference. One task which must be performed is the creation of the virtual worlds within which the users interact. This can be a very tedious task, since a complete description of all virtual objects in the virtual world, including their constraints of motion, hierarchy, color, texture and other attributes must be made and entered into the virtual reality computer. Thus, it would be desirable to make virtual world creation as simple as possible.

SUMMARY OF THE INVENTION

The present invention is a method and apparatus for creating virtual worlds wherein a user may begin with a database containing a limited pictorial representation of a desired virtual world and then edit the database to specify the remaining data needed to create the actual virtual world. In one embodiment of the present invention, a database containing a limited pictorial representation of a virtual world is communicated to a receiving unit, and a grouping unit collects various descriptions of the pictorial representation into selected groups. An attribute assigning unit then assigns attributes to the groups. The attributes may include group hierarchy, constraints of motion, color, texture or other features. The modified database is then communicated to a data coupling unit which couples real world data to the groups. Finally, a rendering unit renders the virtual world which looks and functions according to the specified attributes and the real world data.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram of a particular embodiment of an apparatus for creating a virtual world according to the present invention.

FIG. 2 is a series of menus used in a computer implementation of the present invention to control receiving pictorial representations of objects, grouping objects and assigning attributes to objects in a virtual world;

FIG. 3A is a pictorial representation of two objects and a single connecting edge (indicated by the arrow) that connects the two objects; and

FIG. 3B is a grouped, sweep polygon object created from the pictorial representation of FIG. 3A after being grouped.

BRIEF DESCRIPTION OF THE APPENDICES

Appendix 1 is a source code listing of a program used for creating a virtual world database according to the present invention;

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Appendix 2 is a text description of the operation of the operation of the program entitled "Starch" listed in appendix 1;

Appendix 3 is a text description of the operation of the program entitled "Wringer" listed in Appendix 1; and

Appendix 4 is a text description of the overall steps used to create a virtual world according to the present invention.

DESCRIPTION OF SPECIFIC EMBODIMENTS

1. Project Description

The Matis database conversion project enables the use of the Matis kitchen database in a virtual reality environment. To accomplish this, the Matis kitchen files are converted into the Isaac file format via RB2Swivel.

This conversion process has several steps. First, the Matis product files are edited, using the STARCH editor. The added editing information is stored in a GROUPING file which can be reloaded into the editor. Once the editing is complete, the product is converted into an RB2Swivel Script file. Once the products needed to construct a kitchen are in dm RB2Swivel format, the WRINGER program builds an RB2Swivel Script file containing the information necessary to make a virtual world. The RB2Swivel worlds are then loaded into Body Electric, along with the Body Electric Data Massagers (DMs) necessary to animate the word.

FIG. 1 shows a general outline of the conversion process. The GROUPING of the Matis database will be available for use on Sun Microsystems computers.

2. The STARCH Editor

This program runs on the SGI and enables the user to convert Matis product data into the GROUPING file data format. The final output format of the editor is RB2Swivel Script files. The GROUPING data file contains all the information necessary to edit a product from its last saved state. This information can also be used to speed the editing of similar products. Once editing is completed, the grouped Matis product data is converted temporarily to the SOAP data format. It is then converted to a Swivel Script file. There is one Swivel script file per product.

The editor provides file tools necessary for the grouping of matis graphic primitives into polygons or sweeps. Additional information such as constraints, thickness, and color can then be added.

2.1 Product Selection

The user needs to select which product to edit. This is accomplished by entering either the product number or name, or by cycling through the list of products of a kitchen as contained in the Matis planfile.

There is one GROUPING file per product. If a product which has already been edited is reselected for editing, the user is asked to confirm his intentions.

2.2 Default Parameter Addition

When a product is initially selected for conversion editing, default values for color, grouping, constraints, and thickness are added whenever possible.

Grouping defaults are a non-trivial problem. Currently, grouping is accomplished interactively. Future project phases may automate this process.

On completion of the grouping of graphic primitives into a part, a part name can be supplied by the user, or default to a predetermined value in order to establish constraint and thickness defaults.

Color, Thickness, and Constraint defaults are determined upon entry of a part name, such as door.

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2.3 Product Editing

The grouping view also supports hierarchy editing. It displays an indented notation tree structure which specifies the Swivel linking constraints of the parts. The default relationship of the parts is a flat tree structure where every part is a child of the root (the product).

COLOR VIEW

This view displays the RGB color value of the current part.

The four functions which the editor must provide are the ability to group Matis graphic primitives and subprimitives into parts, edit product color information, determine physical constraints, and add part thickness. This is accomplished in a one screen editing environment consisting of 8 views:

MATIS GRAPHIC VIEW

This view displays the original Matis data as a 3-D rotatable wireframe object. This view is used for selection and feedback, but is not modifiable, except for the addition of user polygons and constraint origins.

MATIS TEXT VIEW

All of the graphic primitives which compose the product are displayed in this view in a text list format. The association of text to graphics is accomplished through the use of color and highlighting. Primitives which can be subdivided into subprimitives have menu entries representing rite subprimitives.

Grouping Process

One or more primitives and subprimitives are selected. They are then grouped using the appropriate grouping menu item, at which time a part name can be supplied. This name then appears in the Grouping text view. When the one or more primitives and subprimitives are grouped, either a polygon or a wireframe part is generated as the result. If the definition of the polygon is not planar, it will be grouped as a sweep polygon automatically. A sweep polygon is defined by two sets of lines and arcs, each element in one set is parallel to a mirror image element in the other set, and the sets are connected by a single edge describing the thickness. Sweeps may also be created implicitly, as part of a thickened polygon.

Two objects in a virtual reality world may be assigned as connected hierarchically. The hierarchy is created by selecting an object and designating it as a child object of another object.

Objects additionally can be assigned as rotatable about a portion of another object. This is necessary only if the part is unconstrained in some way. For instance, a door needs to rotate about one of its edges. To define a rotational constraint of motion for an object, the edge about which an object will rotate is selected. The origin will be set to the center of the edge if a line segment is selected, or the origin will be set to the center point of the defining endcap of a column if a column is selected. For example, to allow a faucet arm to swing side to side, an origin must be specified, and then the

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minimum and maximum constraint values must be set. Once an object or a grouped object has been designated as rotatable about an origin, a change in an angle of rotation will cause the selected object to rotate about the origin by the specified amount.

GROUPING TEXT VIEW

This view contains a list of the part names of the currently grouped parts. When one of the names is selected, the primitives which compose the part will become selected.

THICKNESS VIEW

This view consists of editable text items which enable thickness to be added to the currently selected part. The editable items are height and height type. The height is the measurement by which to thicken the selected part in the direction of its normal vector. The height type specifies whether the thickness is added to the positive direction, negative direction, or equally distributed.

CONSTRAINTS VIEW

This view displays positional and rotational constraints of the currently selected part. It displays the current, minimum, and maximum constraint values, as well as lock status.

CONVERSION (SOAP) VIEW

This view displays the most recently convened state of the product. The product is displayed in shaded, polygonal format.

COLOR GRID VIEW

This view displays a color grid from which to interactively specify a grouping's color. This view only appears in Soap Edit mode, as described in the Starch User's Manual, Section 4.4, and replaces the Matis Graphic View.

3. The WRINGER World Constructor

This module constructs a kitchen as determined by the Matis index and plan files. Its one interaction with the user is to select a particular kitchen to build. A master Swivel script file is output by this module and is ported to the Macintosh, and loaded into RB2Swivel.

3.1 Kitchen Selection

The user can input the index file entry number or the managing number as a command line argument when running the module. Wall, floor, and ceiling colors may also be specified by creating a "wringer.color" file. See the Wringer User's Manual for more details.

3.2 Making a World

The plan file referenced by the index fie entry is loaded.

A new RB2Swivel script file is then written. As each wall is created, its products are located upon it as specified by the plan file. The file includes a head and hand, and initial world orientation information.

4. Body Electric Interaction

DMs are defined for each type of movement that might be needed. They are then loaded by BE by indexing off the key part names in each product. This loading process occurs automatically when a world is loaded into BE.

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[54] **METHOD AND APPARATUS FOR CREATING A WIREFRAME AND POLYGON VIRTUAL WORLD**

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Related U.S. Application Data

[63] Continuation of Ser. No. 621,474, Nov. 30, 1990, abandoned.

[51] **Int. Cl.**[6] **G06F 9/455**

[52] **U.S. Cl.** **395/500**; 395/119; 395/133

[58] **Field of Search** 395/500, 600, 395/700, 100, 119, 133

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